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REMINISCENCES OF PHYSICS AND PHYSICISTS[1]

By SIR JOSEPH J. THOMSON

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WHEN I, somewhat light-heartedly, accepted Sir William Bragg's invitation to give a Friday evening discourse on incidents in my memory connected with the Royal Institution, I did not realize how difficult the task would be. It was difficult to find a name for the lecture and difficult to know what to select from the many events which have occurred in the sixty years during which I have been connected with the institution or been in touch with those who were. Finally, I decided that perhaps the best thing I could do would be to choose some of the outstanding discoveries in this period and consider them in connection with the institution. Not a few of these have been made by its professors; all have been the subject of "Friday evenings" soon after they were made when they had the charm and simplicity of youth. The experiments I shall show will be those made at the time. I do not think we can realize what great achievements these discoveries were unless we take into consideration the very rough means, according to modern ideas, which had to be used to make them.

This lecture must necessarily be somewhat personal, and I hope to be excused if I take this opportunity of acknowledging the debt I owe to my first teachers in science at the Owens College, Manchester. I went to the Owens College, now the University of Manchester, through a mere accident. It was intended that I should be an engineer, and in those days the only way to do this was to be apprenticed to some big engineering firm. The firm I was to go to had a very

[1] Friday evening discourse before the Royal Institution of Great Britain.

long waiting list and told my father it would be a long time before I could be taken on. A friend to whom my father mentioned this said, "If I were you I should send him while he is waiting to the Owens College; it must be a pretty good kind of place for young John Hopkinson, who was educated there, has just come out senior wrangler." My father took this advice and I was sent to Owens when I was not fifteen years old; this was thought such a scandal that the authorities passed a resolution that in future no one under sixteen should be admitted.

In those days the college was a house in which Cobden had lived; it was by no means large and we were much cramped for space. The lectures on engineering were given in what had been the stable, and the drawing office was a converted hay loft. But though the building was so poor, few universities have had such a brilliant staff of professors. There was Balfour Stewart for physics, Roscoe for chemistry, Osborne Reynolds for engineering, Thomas Barker for mathematics, W. Crawford Williamson, the great paleo-botanist, James Bryce, who was afterwards ambassador to the United States, Adolphus Ward, the historian, who afterwards became Master of Peterhouse, and Stanley Jevons, the political economist.

The teaching at Owens College sixty-three years ago was as good as I could get anywhere if I was beginning my studies now. My first introduction to physics was the lectures of Balfour Stewart. These were so clear that, child as I was, I could understand them. He was a very interesting man with a strong metaphysical turn, and with P. G. Tait wrote a book "The Unseen Universe" which attracted a good deal of attention when it appeared. Barker, the professor of mathematics, though as far as I know he never published a paper, was as good a teacher as any one I ever came across. His methods were not altogether orthodox, since under him I learned quaternions before Cartesian geometry. I do not think this order would in general be recommended, but I think we worked the better for it, we looked upon ourselves as pioneers and felt that it was up to us to make good.

As I was taking the engineering course the professor I had most to do with in my first three years at Owens was Osborne Reynolds, who, too, forms a connection with the Royal Institution. He was one of the most original and independent of men and never did anything or expressed himself like any one else. It was difficult to take notes at his lectures, the result being that the student had to read his textbooks more diligently. In fact, it was only in his Friday evening discourses at the Royal Institution that he expressed himself so that he could be immediately understood. He was a great personality, one of his outstanding characteristics being that when he took up a problem he began to think it out for himself from the beginning. This I think is a better way than that of beginning by forming a bibliography and reading the literature. Many people's minds are more alert when they are thinking than when they are reading, and they are less apt to accept as satisfactory some plausible explanation which will not bear criticism. Osborne Reynolds did important work on the discontinuity of the motion of a fluid flowing through a pipe; a fundamental constant in this subject is called the Reynolds constant, on lubrication, on the calming of waves by rain, on the singing of a kettle and on the reason why sound traveling against the wind is not heard as well as when it travels with it. He worked out with great success the consequences which follow from the fact that a collection of equal spheres can be "piled" in different ways, and brought before the Royal Institution many beautiful illustrations of these. He worked out a theory of the universe on the assumption that it consisted of a large number of spheres in contact, and claimed that it was the one, and the only one conceivable, purely mechanical system capable of accounting for all the physical evidence as we know it.

In the early seventies the outstanding subject of interest in physics was Crookes's radiometer, or light mill, which in its commonest form consisted of a system of vanes which could rotate round a pivot supported in a cup of glass. These vanes were blackened on one side and bright on the other and when a light was brought near them they rotated, the direction of the rotation being the same as if the blackened side were repelled by the light. They aroused very general interest, and shopkeepers had them rotating in their windows to attract a crowd.

The discovery of the radiometer by Crookes was a triumph of vigilance in observation and accurate measurement. When he was engaged in making very accurate weighings to determine the atomic weight of thallium, an element which he had lately discovered, he found small discrepancies which he could not account for by any known source of error. He set himself to trace the origin of these, and by ingenious experiments convinced himself that they were due to light falling on the balance. This led him to make *ad hoc* experiments on the effect of light on delicately poised pieces of metal, and hence to the radiometer. At first the rotation was ascribed to a pressure exerted by light on the vanes; such a pressure exists, but in normal conditions the direct pressure of light is far too small to produce rotations such as those which occur in a radiometer. They turned out to be due to the blackened surfaces getting hotter than the bright ones, owing to their absorbing more light. When the molecules of the gas strike against the

blackened side they get hotter and shoot off with a higher velocity than when they strike against the bright one, so that the kick or recoil is greater on the blackened surface than on the bright.

Though the radiometer did not yield anything as fundamental as had been hoped, and it may be said deserved, yet it was the means of leading Crookes to devote himself to the study of high vacua and to cathode rays. The work occupied him for many years and resulted in some of the most beautiful experiments known to physics, with which year by year he delighted audiences at the Royal Institution. These led him to a conception of a fourth state of matter, a state in which the molecules of the gas were so far apart that they could travel across the vessel in which they were contained. He said, and said quite truly, that the properties of such a gas would be quite different from those of one at ordinary pressures, when the molecules can not go more than a very small fraction of a millimeter without coming into collision with another molecule. It turned out, however, and this was first announced at a Friday evening discourse in this room, that the cathode rays were not merely molecules of the gas moving without interference from other molecules, but that they were very much smaller particles—electrons—knocked out of the molecules of the gas, and that these small particles were of the same kind from whatever kind of gas they proceeded, showing that the electron was a constituent of every kind of substance.

Towards the end of the seventies there was an outburst of researches on the passage of electricity through gases, a subject whose vital importance in connection with the structure of molecules and atoms was just beginning to be realized. Warren de la Rue and Müller, Spottiswoode, Moulton and Schuster all made important researches in this branch of physics. The experiments of de la Rue on striations in the electric discharge are of quite exceptional interest and beauty. The "Friday evening" at which he gave an account of them was on the heroic scale. The preparation of the experiment occupied, I believe, nine months. He set up in the institution, for his lecture, a battery of 14,000 cells. The tubes which I have before me on the table, and which have remained in the institution ever since the lecture more than fifty years ago, are witness of the abundance of the experiments with which the lecture was illustrated. It was rumored that he spent many hundreds of pounds on its preparation.

With the nineties began a series of discoveries following one another in quick succession, to which that much-abused term "epoch making" may be appropriately applied.

In 1891 in one of the lectures given in commemoration of the centenary of the birth of Faraday, Dewar exhibited liquid oxygen in bulk, following this first with liquid air and then with liquid hydrogen. He continued his low temperature researches for many years. Two of the discoveries he made were even greater achievements than the liquefaction of gases; one of these was the vacuum jacket, impervious to heat, called the thermos flask, but which ought to be called the Dewar flask, which has been a joy and comfort and a help to millions spread over every country in the world. The other discovery was that of producing high vacua by absorbing the gases by charcoal cooled with liquid air. Most of the discoveries in modern physics have been made by studying molecules as individuals and not as crowds. To do this we must have high vacua. Every improvement in the vacuum has resulted in new discoveries. The charcoal method gave us better vacua than we had had before and many important discoveries could not have been made without it.

In 1894 argon was discovered by Lord Rayleigh whom both the Royal Institution and the Cavendish Laboratory can claim as one of their professors. This discovery is one of the romances of science; it has been described more prosaically as the triumph of the third place of decimals. It was due to Lord Rayleigh finding that the weight of the gas in a vessel was 2.31 gm when the vessel was filled with nitrogen obtained from the air, while it was only 2.30 gm when it was filled with nitrogen obtained from chemical compounds of nitrogen. This difference, less than one half of one per cent., led, in the hands of Lord Rayleigh and Sir William Ramsay, to the discovery of the new element argon. It is a striking example of the way accurate measurement may lead to most fundamental discoveries. It seems hardly possible, however, that any discovery would lead to more startling results than this, for it was found that more than 1 per cent. by weight of the atmosphere consisted of argon, so that there are pounds of it in a fair-sized room and hundredweights in most chemical laboratories. Moreover, the discovery was not made by using some new-fangled physical apparatus of which chemists are so shy, but by the balances which abound in every chemical laboratory and in the use of which chemists are expert. No wonder the chemists were incredulous; they could not believe that with their delicate methods, by which they can detect fractions of a milligram of most substances, they could have missed pounds of argon. It is the most wonderful case on record of a successful attempt at escape from detection, and succeeded because argon, so to speak, kept itself to itself, and would form no alliances with the most attractive brides offered to it by the chemist. But though argon had taken the measure of Scotland

Yard it had forgotten Sherlock Holmes and when he took a hand the game was up. Besides the discovery of argon, 1894 was memorable for Hertz's discovery of electric waves. The "Friday evening" given by Sir Oliver Lodge on this discovery was one of the most outstanding in the long roll of these discourses. The next year marked the discovery of Röntgen rays. It would, I think, be a striking example of the importance of research in pure physics in promoting employment, if we had the figure for the number of people in this country employed in the industries created by the discoveries made in the decade 1890–1900; the number of people employed in the manufacture of thermos flasks, in broadcasting, in the manufacture of the instruments used for wireless and for the medical applications of Röntgen rays.

This lecture is on reminiscences connected with the Royal Institution, so that accounts of quite recent discoveries would not be within its scope. There is one subject, however, which is now attracting a good deal of attention—heavy hydrogen—which satisfies both conditions; it is a reminiscence and it is connected with the Royal Institution. In 1911 I gave a Friday evening discourse "On a New Method of Chemical Analysis."[2] By this method each kind of gaseous particle in a vessel through which an electric discharge is passing produces its own parabolic curve on a photographic plate. Thus if the vessel contained a mixture of hydrogen, oxygen and nitrogen there would be six parabolas corresponding to the atoms and molecules of hydrogen, oxygen and nitrogen, respectively, along with others due to each of the compounds formed by these elements. The mass of the particle which produces any parabola can be determined from the position of the parabola.

Using this method, I detected the presence of a parabola which must have been produced by a particle of mass 3 (the mass of the hydrogen atom being taken as the unit). I obtained it first when the gas in the discharge tube was hydrogen prepared in the ordinary way, but its appearance was very capricious, and only occurred in a small percentage of the experiments. I found, however, that if, instead of using ordinary hydrogen, I used the gases given off by certain solids when bombarded with cathode rays, the (3) parabola appeared with great regularity. The amount of the gas producing it varied with the nature of the solid bombarded, but there were few minerals or salts among those I tried which did not give traces of it; potash (KOH) is a very convenient source, and a specimen of black mica given to me by Sir James Dewar gave an exceptionally large supply.

I obtained the active gas also by deflagrating a very thin wire by passing a very large current through it, or even by raising a wire to bright incandescence. This indicates that the bombardment by the cathode rays does not manufacture the gas but merely liberates it from the solid.

I made a very large number of experiments on the gas obtained in this way, the results of which were published in the *Philosophical Magazine* and summarized in my book, "Rays of Positive Electricity" (Longmans). One important property of this gas was that it could be stored after bombardment and tested long after it had been produced, showing that it is a stable gas and can exist in an uncharged state. In fact, the persistence with which it clung to the walls of the discharge tube and the cathode made experiments troublesome, as once the tube had been used for this gas, it would continue to show the (3) parabola after the gas had been pumped out and replaced by another of a different kind; long sparking with oxygen in the tube is required to get rid of it.

I made many tests of the chemical properties of this gas and found that under them it behaved like ordinary molecular hydrogen. Thus, for example, it disappeared after vigorous sparking in the presence of oxygen, or when passed slowly over red hot copper oxide; again like hydrogen it can pass through red hot palladium; and there was evidence that when an electric discharge was passed through it, some of its molecules were split up into a positively charged hydrogen molecule and a negatively charged hydrogen atom.

Through the kindness of Lord Rutherford, I have had the opportunity of examining by the positive ray method samples of 80 per cent. concentration of heavy hydrogen prepared by recent methods. Very interesting photographs obtained with heavy hydrogen of less concentration have been published by Professor P. Zeeman. So far as I can see, the heavy hydrogen behaves in just the same way as the form of hydrogen obtained by bombarding solids. With these high concentrations, so much heavy hydrogen adheres to the walls of the tube that instead of trying to get rid of it by bombarding with oxygen, it saves time to make a new tube for each experiment. Again, with the highly concentrated gas, I found, as Professor Zeeman had done, parabolas corresponding to H_4 and H_5; in my early experiments a parabola (4) was frequently seen along with H_3. I ascribed it to helium and probably some of it was due to this source, but now I think part of it may have been due to H_4; on a few occasions, too, I observed a line corresponding to H_5. The evidence seems to me to leave little doubt that the gas I called H_3 more than twenty years ago is the same as that which is now called heavy hydrogen.

I said in "Rays of Positive Electricity" that from

[2] *Proc. Roy. Inst.*, Vol. XX, p. 140.

my experiments I suspected that there might be two kinds of H_3; this surmise is confirmed by the fact that many chemists who have experimented on triatomic hydrogen have come to the conclusion that it has a life of only a minute or so, and can only exist when charged with electricity. So far as I know, they all used hydrogen prepared in the usual way and not that obtained by bombarding solids; there is not the slightest doubt that the H_3 obtained in the latter way is stable and can exist uncharged.

I think the effect of the solid is due to its adsorbing a mixture of gases including H_2 and H_3, and that when it is bombarded, relatively more H_3 than H_2 comes off from the adsorbed layers. Thus the mixture that comes out is richer in H_3 than the mixture in the gas adsorbed by the solid.

ROCK FORMATIONS OF DEATH VALLEY, CALIFORNIA[1]

By Dr. L. F. NOBLE

U. S. GEOLOGICAL SURVEY

PRELIMINARY STATEMENT

DURING the past two years the Geological Survey has been making a study of the geology of Death Valley. The area under investigation includes all Death Valley south of parallel 117° 30′ (which crosses Death Valley four miles north of the Furnace Creek Ranch) and enough of the neighboring territory to provide evidence necessary for an understanding of the general stratigraphic and structural relations of the region. The area is included in the northern half of the Avawatz Mountains topographic map and the southern half of the Furnace Creek topographic map and adjoins on the south the area described and mapped by Ball,[2] whose work covered all the region north of parallel 117° 30′. The investigation, which is designed to attain the scope of a fairly thorough geologic reconnaissance, is being carried out by the writer. Two winter seasons of field work have been completed with the aid of a mosaic of air photographs taken specially for the project. During a part of the first season the writer was assisted by C. L. Gazin.

At the time when the investigation was begun little was definitely known concerning the age, character and distribution of the rocks in the area and almost nothing concerning the structure. The first step in the investigation therefore was to determine the age and sequence of the rocks, without which knowledge it is impossible to decipher the structure. The field work thus far has been devoted to obtaining this fundamental knowledge. It remains to work out the structure and to supplement the stratigraphic reconnaissance by a more detailed study of some of the rock formations.

In the statement which follows no attempt is made to describe the rocks systematically or in detail. For example, the term granite is used for rocks that range in composition from granite to quartz diorite, and the term limestone is used for both limestone and dolomite. Thicknesses given for formations are only rough estimates, because few detailed sections have been measured. Lists of fossils found in the Paleozoic strata and the reports on these fossils made by Survey paleontologists will be reserved for another paper.

[1] Published by permission of the Director, U. S. Geological Survey.

[2] S. H. Ball, "A Geologic Reconnaissance in Southwestern Nevada and Eastern California," *Bull. U. S. Geol. Surv.*, 308, 1907.

AGE AND CHARACTER OF THE ROCKS

The Death Valley area contains rocks of all the great geologic time divisions—Archean, Algonkian, Paleozoic, Mesozoic, Tertiary and Quaternary—whose aggregate thickness certainly exceeds 30,000 feet for the stratified rocks alone, but earth movements in the area have been so profound and so recurrent that the rock masses form a complex mosaic of crustal blocks isolated one from another by folding, faulting, tilting, igneous intrusion, erosion and burial under Quaternary alluvium. Consequently, the sequence is not complete at any one locality and can be pieced together only by examining many different parts of the area.

PRE-CAMBRIAN ROCKS

Archean rocks.—The rocks of the oldest system, the Archean, are the basal rocks of the region. They are chiefly gneisses and mica schists but include bodies of quartzite and limestone. A common type of gneiss is remarkably coarse and granitic and contains conspicuous large crystals of pink feldspar. Another common type is a dark gray dioritic gneiss or metadiorite. All the Archean rocks have been recrystallized by heat and pressure and contain no recognizable traces of life. In origin they are in part igneous and in part sedimentary. As a whole they greatly resemble the Archean rocks that make the Granite Gorge in the bottom of the Grand Canyon. Like the Grand Canyon Archean rocks they are separated from an

overlying series of pre-Cambrian strata by a profound unconformity. This unconformity is well exposed at several places in the Death Valley area.

Algonkian rocks.—The pre-Cambrian strata overlying the Archean are a series of limestones, shales, sandstones and conglomerates which at many places contain bodies of a dark basic igneous rock that was injected into them as sills and dikes in pre-Cambrian time. The thickness of the series may be as much as 7,000 feet, although no complete section is exposed at any one locality. As pieced together from a study of many different localities the succession from the base upward is broadly as follows:

GENERALIZED SECTION OF ALGONKIAN, DEATH VALLEY REGION

Unconformity at top	Feet
4. Sandstone, conglomerate, and shale in alternating beds	1,500
3. Limestone, gray algal, locally as much as	1,000
2. Limestone, varicolored shale, and sandstone in alternating beds; irregularly intruded by basic igneous rocks; estimated thickness	4,000
1. Sandstone and conglomerate, minimum thickness	500
Unconformity at base.	7,000

The only fossils found in the strata are algae which, in some limestone beds, are so abundant as to constitute the entire rock. The series is separated from the underlying Archean rocks by the unconformity just mentioned and from overlying Paleozoic rocks of Lower Cambrian age by an angular unconformity that is well exposed at many places and is as profound as the similar unconformity in the Grand Canyon that separates the Algonkian Grand Canyon series from the overlying Paleozoic, for at one place and another in the Death Valley area it bevels the upturned edges of all the units in the pre-Cambrian sedimentary series and the Archean rocks as well.

Comparison with Algonkian in Grand Canyon.—The presence in the Death Valley region of the pre-Cambrian strata just described is of considerable interest. In the opinion of the writer the Algonkian rocks of Death Valley are as a whole roughly equivalent to the Algonkian Grand Canyon series (Unkar and Chuar groups), which he has previously studied.[3] Not only do the Death Valley Algonkian strata occupy a similar stratigraphic position between rocks of Archean and Cambrian age, but they strikingly resemble the Grand Canyon Algonkian strata in lithology and were obviously deposited under similar conditions, containing, as they do, great thicknesses of similar sandstone beds, similar beds of bright red shale exhibiting sun cracks and ripple marks, similar algal limestones and masses of similar basic igneous rock. As contrasted with the Grand Canyon section, the Death Valley section contains more limestone, more conglomerate and more and thicker sills of basic igneous rock. The Death Valley Algonkian rocks, moreover, are much more disturbed and altered than the equivalent Grand Canyon rocks. At most places shale is altered to slate, jasper or schist; sandstone to quartzite; and limestone to marble. Most of the basic igneous rocks are altered to greenstone. Deposits of talc are associated with the contacts of greenstone and limestone in the Death Valley Algonkian in much the same manner that deposits of serpentine asbestos are associated with similar contacts in the Grand Canyon.

Other comparable Algonkian occurrences.—The most complete section of the Algonkian strata in the region here discussed is exposed in the Kingston Range just east of the Death Valley area. This section, which has been studied by Hewett[4] and will be described by him in his forthcoming report on the geology of the Ivanpah quadrangle, undoubtedly constitutes the type section for the Death Valley region.

In the opinion of the writer the rocks that constitute the Telescope group of the Panamint Range described by Murphy[5] may prove to be correlatives of the Algonkian rocks just described. If this opinion is correct, the underlying Panamint metamorphic complex described by Murphy is the Archean of the Death Valley area.

It is interesting to note that the Paleozoic beds which unconformably overlie the Death Valley Algonkian strata are Lower Cambrian, whereas those which similarly overlie the Grand Canyon Algonkian strata are Upper Cambrian. This fact, assuming that the Death Valley and Grand Canyon Algonkian beds are correlatives, would appear to afford conclusive proof of the pre-Cambrian age of the Grand Canyon beds, about whose pre-Cambrian age some doubt has been entertained, despite the magnitude of the erosion interval above them.

PALEOZOIC ROCKS

The Paleozoic rocks include strata of Lower Cambrian, Ordovician, Devonian and Mississippian age that have been dated definitely by finding fossils in them; also strata containing fossils that are probably

[3] L. F. Noble, "The Shinumo Quadrangle, Grand Canyon District, Ariz.," *Bull. U. S. Geol. Surv.*, 549, pp. 37–60, 1914.

[4] D. F. Hewett, personal communication.

[5] F. M. Murphy, "Geology of a Part of the Panamint Range, Calif.," *Rep. 28, California State Mineralogist*, July–October, 1932, p. 336.

early Pennsylvanian. Beds are present in the section that there is reason to believe are of Middle Cambrian, Upper Cambrian and Silurian age, although their ages have not yet been established definitely by finding fossils. No beds of Permian age have been identified. Apparently all the Paleozoic strata were deposited beneath the sea. The most abundant fossils in the Lower Cambrian beds are trilobites, in the Ordovician beds gastropods, in the Devonian corals, and in the Mississippian crinoids. Algae are abundant in many Cambrian beds.

The aggregate thickness of the Paleozoic strata is as much as 15,000 feet and may be much greater. At least a third of the section is Lower Cambrian. The basal unit of the section is a massive bed of limestone which weathers buff and which at some places is at least 1,000 feet thick. Above the limestone are at least 5,000 feet of beds which are chiefly sandstone (quartzite) but which include conglomerate, shale and limestone. Lower Cambrian fossils were found in limestone beds interstratified with shale near the top of this unit. Then follow 5,000 feet or more of very massive beds of limestone characterized in the upper part by broad alternating bands of light and dark gray that are conspicuous from great distances. Much of the limestone is a dark bluish-gray rock with a peculiar mottled appearance that is commonly associated with Cambrian limestones in the region. Beds of greenish and reddish shale that may be Middle or Upper Cambrian are present at the base of the limestone. Lower Ordovician (Pogonip) fossils were found in the banded beds near the top of the limestone. The unit as a whole is believed to be part Ordovician in age and part Cambrian, but the line of separation between the Cambrian and Ordovician beds has not been established nor is it known what divisions of the Cambrian the lower part of the unit represents, although there is reason to believe that much of it is Upper Cambrian. It is certain that the unit is equivalent in part at least to the lithologically similar Goodsprings dolomite of the region just east of the Death Valley area described by Hewett,[6] although the unit is apparently much thicker than the Goodsprings dolomite. Above the unit just described follow several hundred feet of quartzite that may represent the Middle Ordovician Eureka quartzite; then follow several thousand feet of light and dark limestones in which the writer has found Devonian fossils a few hundred feet above the base and Mississippian fossils a few hundred feet below the top. Fossils that are probably of early Pennsylvanian age have been found by Professor J. W. Wolff and Mr. J. H. Maxson in limestone beds at the head of Warm Springs Canyon in the Avawatz Mountains quadrangle, but the relation of these beds to the other Paleozoic rocks of the region has not yet been studied by the writer.

The thick bed of limestone at the base of the Lower Cambrian is for stratigraphic purposes one of the most important rock units in the area. The pale buff color and massive character of the bed render it conspicuous from great distances, so that it serves as a marker to guide the observer to the base of the Paleozoic and the unconformity between the Paleozoic and the underlying Archean and Algonkian. The bed has not been found north of Furnace Creek, but it crops out at many places in the southern part of the Death Valley area. Numerous isolated patches of it are found lying upon the Archean and Algonkian rocks in the most unexpected places. At most places the limestone is intensely shattered and at some places a bed of conglomerate or breccia lies at the base of the limestone. The bed just described has been studied by Hewett in the northwestern quarter of the Ivanpah quadrangle adjoining the Death Valley area. He states[7] that the limestone is a dolomite; that the type locality is at the Silver Rule mine on the northwest slope of the Kingston Range where the bed is 2,000 feet thick, thinning rapidly eastward and southward; that it lies unconformably upon Archean and Algonkian rocks, as in the Death Valley area; and that no such unit is known elsewhere in the region to the south or east.

MESOZOIC ROCKS

So far as known the Mesozoic era is represented only by masses of granite which in places has been injected into rocks of all the older systems. The apparent absence of Permian and Mesozoic sedimentary rocks in the Death Valley area is puzzling, because thousands of feet of them are present in Spring Mountain[8] scarcely 30 miles east of the area, where they include the Permian Supai formation and Kaibab limestone, the Triassic Moenkopi formation, Shinarump conglomerate and Chinle formation, and the Jurassic (?) Aztec sandstone, and extend with undiminished thickness far eastward; and because thousands of feet of Mesozoic beds are present in the Inyo Mountains[9] scarcely 30 miles west of the area. The beds in the Inyo Mountains are of Triassic age but are of a type wholly different from the Triassic

[6] D. F. Hewett, "Geology and Ore Deposits of the Goodsprings Quadrangle, Nev.," *Prof. Pap. U. S. Geol. Surv.*, 162, pp. 11–13, 1931.

[7] D. F. Hewett, personal communication.

[8] C. R. Longwell, "Structural Studies in Southern Nevada and Western Arizona," *Bull. Geol. Soc. Amer.*, 37: 4, 557–558, December 30, 1926; D. F. Hewett, *op. cit.*, pp. 9, 10.

[9] Adolph Knopf, "A Geologic Reconnaissance of the Inyo Range and the Eastern Slope of the Southern Sierra Nevada, Calif.," *Prof. Pap. U. S. Geol. Surv.*, 110, pp. 47, 48, 1918.

rocks in Spring Mountain. It is possible that the structural study of the Death Valley area will suggest the reason for the absence of the Permian and Mesozoic rocks, or it is equally possible that some of these rocks have escaped recognition and will be found when the writer has covered the area more thoroughly.

TERTIARY ROCKS

The Tertiary rocks lie unconformably upon the upturned and eroded edges of all the older rock systems and, next to the Quaternary deposits, are the least disturbed and altered rocks in the area, but even they have been profoundly disturbed, as one may see in descending the long valley of Furnace Creek, which is cut in them. They comprise at least two unconformable series much alike in general character, which have not yet been satisfactorily separated. The aggregate thickness of the Tertiary strata is difficult to estimate until they have been studied in more detail, but it is believed to be at least 10,000 feet. The Tertiary rocks include sandstone, conglomerate, shale, limestone and a great amount of volcanic material—part of which was ejected as lava, breccia and ash, and part of which was injected into the adjacent rocks as dikes and irregular masses. Volcanic activity appears to have prevailed during all the time that the Tertiary deposits were being laid down. Much of the older volcanic rock is rhyolite and andesite; much of the younger volcanic rock basalt. None of the Tertiary rocks were laid down beneath the sea. The shales were deposited as mud and clay in dry lakes like those which exist at present; the sandstones and conglomerates were deposited as sand and gravel on alluvial slopes like those which now cover large parts of the region.

One interesting feature of the Tertiary rocks is the extreme coarseness of some conglomerates and breccias, some of which contain rock fragments 100 feet or more in diameter. Certain breccias of granitic material in the Tertiary series are so coarse and so angular and contain so little matrix that at first sight they resemble granite in place. In origin they appear to be talus deposits laid down against fresh slopes or cliffs, a relation which suggests that the Tertiary deposits were laid down in basins bordered by steep fault-line scarps like the scarp which now borders Death Valley at Dante's View. In other words, the Tertiary basins were structurally similar to basins like the present Death Valley trough. Another interesting feature of some of the Tertiary beds is their astonishing variability in thickness within short distances. In Copper Canyon, for example, a bed of gypsiferous clay lying in a coarse breccia-conglomerate was observed to expand from zero to a thickness of a thousand feet in a distance of a few hundred yards. The Tertiary rocks are interesting also for their weird colors, of which the beds along Furnace Creek and at Ryan are an example, and for the deposits of saline minerals which the shales contain, as, for example, boron minerals (chiefly colemanite), gypsum, celestite and rock salt.

No remains of animal life have yet been found in the Tertiary beds, although careful search has been made for them. Consequently, the stage of the Tertiary to which the deposits belong is not known. It is believed, however, that most of the deposits are Miocene and that a part of them are Pliocene. Many limestone beds contain algae and are obviously similar in origin to travertine deposits that are forming about warm springs in the region at the present time.

QUATERNARY DEPOSITS

The Quaternary, or youngest deposits, of the region include all the alluvial fans, the great salt deposit in the bottom of Death Valley, many dissected gravel terraces and a series of dissected lake beds that occupy the Amargosa Valley between Shoshone and Tecopa. The lake beds in the Amargosa Valley are of early Quaternary (Pleistocene) age, for bones and teeth of a Pleistocene elephant have been found in an ashbed associated with them at Shoshone. The ash is altered locally to bentonite, which is worked commercially. The Ubehebe craters in the northern part of Death Valley include some cinder cones of very late Quaternary (Recent) age which are probably not over a few hundred years old.

The salt deposit ("Devil's Golf Course") on the floor of Death Valley represents the saline residue of an evaporated lake. Wells 1,000 feet deep drilled in the deposit have gone through alternating beds of clay and rock salt down to that depth without reaching bed rock. Each pair of salt and clay beds may record the drying up of a Quaternary lake. The salt deposit on the floor of the valley may mark the drying up of the last of these lakes that existed in the valley. Sets of very faint shoreline terraces preserved at some places about the margins of the valley may mark the shores of this lake. The shoreline terraces may be seen at Mormon Point, where they are cut on upturned Tertiary beds; at a point about a mile northwest of Ashford Mill, where they are cut in a slope of basalt; and on old alluvial slopes at the mouth of Warm Springs Canyon. The lake marked by the terraces has been described by Blackwelder,[10] who has named it Lake Manly. According to Blackwelder the lake marked by the highest shoreline may have been about 600 feet deep and about 100 miles long.

[10] Eliot Blackwelder, "Lake Manly: An Extinct Lake of Death Valley," *Geog. Rev.*, 23: 3, 464–471, July, 1933.

DISTRIBUTION OF THE ROCKS

ARCHEAN ROCKS

Archean rocks form most of the steep face of the Black Mountains along the eastern edge of Death Valley from Bad Water southeastward to the Ibex Hills and may be examined at many places along the road that follows the east side of Death Valley. At Bad Water they are chiefly gneisses. At Mormon Point the gneisses contain bodies of limestone. The unconformity between the Archean and Algonkian rocks is well exposed in the Ibex Hills at a point one mile north of Ibex Spring. A small area of Archean rocks lies at the south end of the Nopah Range near the Gunsight and Noonday mines. In this locality both Archean and Algonkian rocks are overlain unconformably by the massive bed of buff limestone at the base of the Lower Cambrian. Much of the northeast face of the Avawatz Mountains is composed of Archean gneiss. The base of the mountains is marked by a great thrust fault along which the Archean gneiss overrides Algonkian beds. A narrow belt of sharply folded and overturned Tertiary strata occupies the fault zone.

ALGONKIAN ROCKS

Algonkian rocks form the Ibex Hills and underlie most of the area extending south of these hills to Saratoga Springs and eastward to the Kingston Range. Gilbert[11] measured a section of them many years ago at Saratoga Springs. Later Campbell[12] described them at the same locality. Both Gilbert and Campbell suspected their pre-Cambrian age. The beds in this general locality are readily accessible from the main highway into Death Valley *via* Baker and Shoshone at the place where the road ascends a long alluvial slope from Amargosa River to the pass at the Inyo County line. The Algonkian strata form the ridges bordering the slope up which the road runs to the pass. Patches of the basal buff Lower Cambrian limestone lie unconformably in places upon the Algonkian beds. Still larger exposures of Algonkian beds in the Ibex Hills are visible from the summit of the pass. A small area of them in contact with Archean gneiss lies between Ashford Canyon and Jubilee Pass and may be seen from the road that runs down the east side of Death Valley. Other outcrops lie in Warm Springs and Anvil Springs Canyons on the Panamint side of Death Valley. If the Telescope group of Murphy is in fact Algonkian, then Algonkian beds form most of the crest of the Panamint Range and may conceivably be thrust over Paleozoic beds that appear to form much of the eastern slope. This eastern slope of the range has not yet been investigated.

[11] G. K. Gilbert, U. S. Geog. Survey W. 100th Mer., vol. 3, 1875, p. 170.

[12] M. R. Campbell, *Bull. U. S. Geol. Surv.*, 200, p. 14, 1902.

PALEOZOIC ROCKS

Paleozoic rocks form the Resting Springs and Nopah Ranges east of Amargosa Valley where they are conspicuous from great distances by their broad banding of light and dark gray, which suggests the stripes of a zebra. There is no more weird sight in the region than the striped Nopah Range as viewed from Chicago Valley in the afternoon light. Paleozoic rocks also form all the southwest face of the Funeral Mountains north of the road between Death Valley Junction and the Furnace Creek Inn and are likewise conspicuously banded. Eagle Mountain, near Death Valley Junction, is also composed of them. The Paleozoic section in the Nopah Range is the most complete in the region, extending, as it does, from the base of the Lower Cambrian at the Gunsight mine to and into Carboniferous beds above the pass at the north end of the range. The section in the southwest face of the Funeral Range is nearly as complete and the beds are likewise successively younger from west to east. At Echo Canyon, for example, the beds contain Lower Cambrian fossils; at Pyramid Peak they contain Ordovician fossils, which are very abundant in the stream cobbles washed down into Furnace Creek from the peak; still farther east, at the tip of the range northwest of Death Valley Junction, Mississippian fossils are abundant. Several parts of both sections are repeated by faulting.

MESOZOIC ROCKS

The largest exposures of Mesozoic granite in the Death Valley region are in the area described by Ball north of the area studied by the writer. One large body lies at the head of Cottonwood Canyon north of Emigrant Wash, where it cuts Carboniferous and Ordovician beds. A smaller body cuts Carboniferous and Algonkian strata in Warm Springs and Anvil Springs canyons in the area studied by the writer. The age of the granite which forms a large part of the Owls Head Mountains is not yet known, as these mountains have not yet been investigated.

In a very general way the pre-Tertiary rocks exposed in the Death Valley area are progressively older from east to west. For example, Spring Mountain, east of Pahrump Valley, is largely composed of younger Paleozoic rocks. The Nopah Range, west of Pahrump Valley, is chiefly Ordovician and Cambrian; the Resting Springs Range, next westward, Lower Cambrian; the Ibex Hills, next westward, Algonkian; and the Black Mountains, still farther westward at the edge of Death Valley, Archean. The reason for the descent westward in the geologic sec-

tion is obviously structural, for the prevailing dip of the beds in all these ranges west of Pahrump Valley is eastward.

TERTIARY ROCKS

The Tertiary rocks are very widely but irregularly distributed throughout the Death Valley area. There is good reason to believe that they underlie the entire Death Valley trough and the parallel Amargosa Valley trough. They underlie the embayments occupied by Furnace Creek and by Emigrant, Wingate, Owl Spring, Ibex and Rhodes Washes, although they are concealed at many places under Quaternary alluvial deposits. In the southern part of the Death Valley trough, as, for example, in the Confidence Hills, they are bent into sharp folds parallel with the axis of the trough, a feature indicating intense compression. They lie irregularly upon the mountain ranges, at places covering the slopes, and at other places forming the entire mountain mass. As a rule the beds dip eastward with the eastern slopes of the ranges, a feature which suggests that the ranges are tilted blocks. Tertiary rocks constitute all the main mass of the Black Mountains from Furnace Creek southward nearly to Bad Water and make the crest and eastern slope of these mountains all the way from Furnace Creek to the Ibex Hills. Several patches of them are involved in the faulting along the western face of the mountains—for example, a small area bordered by Archean rocks lies in Copper Canyon and another similar area lies at the tip of Mormon Point. A small area east of Shoshone is involved in the faulting along the west face of the Resting Springs Range. This area contains a colemanite deposit.

The largest continuous section of Tertiary rocks in the region lies along Furnace Creek and is familiar to all travelers who enter Death Valley by this route. The road that follows Furnace Creek is bordered by these Tertiary rocks all the way from Furnace Creek Inn to Dante's View. Just before reaching Dante's View the road ascends a picturesque canyon in rhyolite tuff and emerges upon rhyolite at the view-point. The Tertiary rhyolite is in contact with Archean gneiss just under and west of the view-point. An even more spectacular exposure of this Furnace Creek section of Tertiary rocks may be examined from the road that runs southward from Furnace Creek Inn to Bad Water. Along this road the rocks border Death Valley for 15 miles south of the Inn and their coloring is even more striking than along Furnace Creek. Golden Canyon, reached by a branch of the road, is in these rocks.

SCIENTIFIC EVENTS

THE INTERNATIONAL CONGRESS ON THE ANTHROPOLOGICAL AND ETHNOLOGICAL SCIENCES

THE International Congress on the Anthropological and Ethnological Sciences was concluded at University College, London, on August 4. Lord Onslow, the president, presided over a general meeting of the delegates in the Great Hall, and presented the report of the permanent council.

A general summary of the business transacted is given in the London *Times*. The congress passed a resolution expressing the opinion that representations should be submitted through the Secretary of State for India to the Government of India urging the need of a permanent organization for the census of India, accompanied by measures for the scientific and continuous collection of information relating to the Somatic types, religions, manners, customs, social organization and social linguistics of India. The resolution added that the system of honorary direction and organization in Assam might be suggested as likely to be of practical value if extended to the whole of India.

Another resolution which was passed recommended to the British Government and to all other governments engaged in the administration of native peoples that it was desirable that in each territory so administered one or more government anthropologists should be appointed as specialist officers, with a view to facilitating a deeper scientific appreciation of native customs and contributing in a scientific manner toward the solution of problems of the contact of native people with European civilization. The congress strongly supported the training in social anthropology of missionaries and government officers who were to work in native territories.

It was decided also to call attention to the urgent need of further research into the methods of investigating the mental aptitudes of African peoples. In a further resolution the need was urged for establishing courses of study in anthropology and ethnology in certain types of schools, and for organizing independent chairs in these subjects in universities.

It was agreed that the next congress should be held at Copenhagen in 1938, with Professor T. Thomsen (Denmark) as president, and that Professor John L. Myres and Alan H. Brodick should be retained as general secretaries. The inclusion in the 1938 congress of a section dealing with biometrics and biotypology was decided upon.

A permanent committee was set up to deal with the

question of scientific film documentation as relating to anthropology. This consists of Professor P. Rivet, Paris; Professor F. Krause, Leipzig; Professor Giuseppe Sergi, Rome; Professor Frans Blom, United States; Captain Thomas A. Joyce, of the British Museum, and Alan H. Brodrick, who will act as rapporteur and organizing secretary. The committee stated that the work which they sought to do was of prime importance and urgency. In less than a generation invaluable material would be lost forever. Primitive races were dying out everywhere.

The committee proposed to set before themselves three objectives: To secure the establishment of a central film library with corresponding libraries in all the principal countries; to save, collate, and compare examples of material often hidden in unlikely places, and to secure the dispatch of special expeditions to those lands where material was to be obtained, and also to endeavor to secure that "amateurs," explorers, colonists, and others should, if they took films, do so in such a way as to be of scientific value. The committee were to undertake at once the preparation of a handbook in five languages giving instructions on the taking of anthropological films.

Speeches emphasizing the importance of anthropological and ethnological research, and the value of the congress in enabling representatives of different countries to meet, were delivered by many delegates, including Professor Lévy-Bruhl, Paris; Professor Sergi, Rome; Professor G. G. MacCurdy, United States; Professor W. Thalbitzer, Denmark; Professor K. Stoyhwo, Poland; Professor E. Pittard, Switzerland; Professor T. Thomsen and Professor G. Thilenius, Hamburg.

The congress numbered more than a thousand members, and delegates from forty-two different countries were present when Lord Onslow delivered his presidential address at the inaugural meeting.

DATA ON THE DROUGHT

NEVER before in the weather history of the United States has so little rain fallen over so wide a territory throughout the entire growing season as this year, according to J. B. Kincer, of the U. S. Weather Bureau. Record-breaking heat has made conditions still worse. Other years, notably 1894–1895, 1901, 1910, 1914, and 1930, were exceedingly dry in many sections, but no year since the bureau, nearly seventy years ago, started recording the precipitation day by day, has had such generally deficient rainfall in April, May, June and July as 1934. Moreover, most of the dry years of the past were preceded by years of adequate rainfall, whereas the last three or four years have been abnormally dry in many parts of the country most seriously affected by drought this year.

Moisture deficiency in the Central Valley began in June, 1933, and in general it has continued ever since with no real relief. The year, June, 1933, to May, 1934, was the driest on record in Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Nebraska and the Dakotas. Also, Minnesota, the Dakotas and most of the northwest had been exceedingly dry for several years before that. The moisture shortage from June, 1933, to the end of July, 1934, was 17.71 inches, or 2,000 tons of water for every acre of land, in Missouri; 15.09 inches in Indiana; 13.14 inches in Iowa; 12.89 inches in Ohio; 11.29 inches in Nebraska, and 9.93 inches in North Dakota.

New lows for April-through-July rainfall were set this year in nine western states: Nebraska, with 45 per cent. of its normal rainfall for the period; Missouri, with 47 per cent.; Utah, with 51 per cent.; North Dakota, with 52 per cent.; Oklahoma, with 55 per cent.; South Dakota, with 57 per cent.; Kansas, with 58 per cent.; Michigan, with 58 per cent., and Colorado, with 60 per cent. Past lows for the same period in the same states were: Nebraska, 58 per cent. in 1894; Missouri, 49 per cent. in 1901; Utah, 54 per cent. in 1897; North Dakota, 54 per cent. in 1900; Oklahoma, 67 per cent. in 1910; South Dakota, 58 per cent. in 1931; Kansas, 62 per cent. in 1913; Michigan, 61 per cent. in 1895, and Colorado, 67 per cent. in 1924.

Normal and above normal rainfall for January through July this year was recorded in only the following states: Florida, with 126 per cent.; Georgia, with 101 per cent.; New England, with 104 per cent.; North Carolina, with 105 per cent., and Virginia, with 101 per cent. Four other states—Alabama, with 99 per cent., South Carolina, with 97 per cent., and Maryland and Delaware, with 96 per cent.—lacked but little of having normal rainfall.

The scanty snowfall in the western mountains last winter has aggravated drought conditions in those sections by cutting down the irrigation water supply. The seasonal snowfall in California was less than half of normal and in Colorado it was about half normal. Wyoming's snowfall was about one third the fall of the preceding year. In New Mexico at the end of March nothing remained but drifts on northern slopes at higher elevations in the northern part of the state.

The situation has been even more seriously aggravated by the extremely high temperatures accompanying the lack of rain. Nothing remotely approaching the severity of this combination appears in the annals of the Weather Bureau. The drought and heat of the growing season will not necessarily affect the crops of 1935, according to Mr. Kincer. Although no amount of rain can now help most 1934 crops in the drought area, good fall rains and abundant snows this winter could restore the soil moisture needed for new seedings, both this fall and next spring.

FIELD OFFICE FOR THE SHELTERBELT PROJECT

WITH establishment of a central field office at Lincoln, Nebraska, planned for an early date, the Forest Service is making plans for beginning field work on the great shelterbelt of trees to be planted for 1,000 miles across the Plains States, which will be carried out by Fred Morrell, administrative director. In addition to the general headquarters at Lincoln, it is expected that state divisional offices will be established in the capital cities of each of the states traversed by the belt—North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma and Texas.

Active work will be started as soon as the necessary organization is completed. Land leases, seed collection and nursery arrangements to supply planting stock on a large scale will be initiated as soon as possible. The pressing need for emergency relief employment is being taken into consideration. Qualified men are being assigned to the project from the Forest Service rolls and are being hired from other sources to speed up the organization of the field work.

Dr. Raphael Zon, director of the Lake States Forest Experiment Station, has charge of technical phases of the work, including the determination of suitable species to plant in the various soil types, nursery selection and practise, planting practise, etc. The Bureau of Chemistry and Soils will assist in the study and classification of soils within the region, and the Bureau of Plant Industry will cooperate actively in technical service and in the use of its established nurseries and other facilities.

Many inquiries for information in regard to the shelterbelt plans are being received from the region and from adjoining states to the east and west. Criticisms to the effect that thousands of trees planted in the region of the proposed shelterbelt in the past have failed to survive have been received. It is pointed out, however, that other thousands of plantings are still surviving, although the plantings were largely haphazard, in many cases of species not especially suited to the region, and seldom given proper care. The Forest Service is undertaking the shelterbelt planting with the benefit of many years of intensive investigation of methods and cultural practises adapted to the dry land areas. Only trees will be used which have already been tested and have shown their adaptability for use in the region, both in point of survival of climatic conditions and in their protective value.

Approximately two million acres in all will be covered in the forest strips, which will be placed about a mile apart, and the lands will be acquired through lease or purchase, by cooperative agreements with the owners, or by donation. The lands will be classified according to soil and other conditions. In the purchase of land the dominant objective will be to determine valuations with equity both to the landowner and the United States.

THE ELM DISEASE EXHIBIT AT THE NEW YORK BOTANICAL GARDEN

THE "brown streaks in the wood" which people have been asked repeatedly to look for in trees suspected of being afflicted with the Dutch elm disease are clearly illustrated in a new exhibit installed this week in the Museum Building at the New York Botanical Garden. The specimens of wood have been taken from a tree near the grounds which the garden authorities cut and burned, with the owner's permission, as soon as its diseased condition was discovered. Also displayed are some of the beetles which carry the fungus disease from tree to tree, by transporting the spores on their bodies.

Part of a limb, with a bark removed, shows the breeding tunnels and feeding galleries of the beetles, while other limbs show how the beetles escape by boring a hole through the bark. In a part of the exhibit contributed by the U. S. Department of Agriculture, beetles are shown feeding in the crotch of an elm twig —one important means by which the fungus enters the wood. Successive stages in the life of the beetle and of the fungus, as well as different types of dark streaks in the wood caused by the fungus, are likewise shown.

In notes appended to the exhibit, it is pointed out that other diseases possess similar symptoms of yellowing, wilting and dropping of leaves and of dark streaks appearing in the wood. It is therefore necessary for a laboratory to make cultures from the infected wood or from the beetles believed to be carrying the disease, to identify the fungus. But once the Dutch elm disease is discovered, immediate action toward cutting and burning the tree is essential, especially at this season when the beetles are emerging and flying to the other trees. Otherwise, the disease will be widely spread among the elm trees of the east. The New York Botanical Garden is cooperating with federal, state and local authorities in its study and eradication.

AWARD OF THE CHANDLER MEDAL

FOR his work in agricultural chemistry, Dr. Jacob Goodale Lipman, dean of the College of Agriculture at Rutgers University and director of the New Jersey Agricultural Experiment Station, has been awarded the Chandler Medal of Columbia University for 1934. The medal will be conferred formally in November. The announcement of the medal committee, of which Professor A. W. Hixson is chairman, reads:

Dr. Lipman's work on the determination of the nature of the chemical action produced by bacteria in making both organic and inorganic components of soils available for plant food has been of great importance to agriculture all over the world.

He introduced certain conceptions in the field of soil bacteriological chemistry that have been shown to be fundamental in the practical handling of soils.

His researches on the utilization of nitrogen by plants, especially upon the soil reactions that influence the availability of nitrogen to plants, are outstanding contributions. His work in general on soil reactions that influence the availability of chemical elements essential to plant growth has led his researches into the study of the soil chemistry of sulphur, phosphorus, selenium, etc.

Dr. Lipman did noteworthy work on the problem of sweetening salt marshes. His chemical studies of the peat and muck deposits of New Jersey have enabled that state to develop a large commercial humus industry.

Dr. Lipman has stimulated investigations by others, and has made the New Jersey school one of the most important centers of research in the field of soil chemistry.

Dr. Lipman was born in what is now Latvia, in 1874, and came to the United States in 1888. His brother, Dr. Charles B. Lipman, is professor of plant physiology and dean of the Graduate Division of the University of California.

The Chandler Medal, awarded annually by Columbia University for conspicuous work in the field of chemistry, was established in honor of Professor Charles F. Chandler, a professor of chemistry at Columbia for more than half a century, and a founder of the American Chemical Society. The former Chandler medallists are: C. F. Chandler, L. H. Baekeland, W. F. Hillebrand, W. R. Whitney, R. E. Swain, E. F. Smith, E. C. Kendall, S. W. Parr, Moses Gomberg, J. A. Wilson, Irving Langmuir, James Bryant Conant, George O. Curme.

Members of the 1934 medal committee, in addition to Professor A. W. Hixson, are Dr. L. H. Baekeland and Professor Arthur W. Thomas.

SCIENTIFIC NOTES AND NEWS

THE hundredth anniversary of the birth of Samuel Pierpont Langley occurred on August 22. Before becoming secretary of the Smithsonian Institution, a position which he occupied from 1887 until his death in 1906, Dr. Langley had been for twenty years director of the Allegheny Observatory. In honor of the centenary a special volume of selections from Langley's writings, describing his most fundamental discoveries in the fields of aeronautics, astronomy, astrophysics and physics, has been prepared by Dr. Charles G. Abbot, secretary of the Smithsonian Institution, and formerly one of Dr. Langley's assistants.

DR. ISAIAH BOWMAN, secretary of the American Geographical Society and chairman of the National Research Council, gave the address of the president at the opening session of the International Geographic Congress, held at Warsaw, Poland, in August.

SIR RICHARD R. STAWELL, of Melbourne, Australia, was elected president for 1935–36 of the British Medical Association at the recent Bournemouth meeting. He succeeds Dr. Sydney Watson Smith, of Bournemouth. The meeting next year will be held in Melbourne.

DR. JOHN R. MOHLER, chief of the Bureau of Animal Industry of the Department of Agriculture, was elected president of the twelfth International Veterinary Congress, which opened in New York City on August 13. Dr. Mohler is vice-president of the permanent commission of the congress, of which Dr. E. Leclainche, director of the International Bureau of Epizootics at Paris, is president. Other officers elected were: Dr. C. P. Fitch, of St. Paul, Minn., *first vice-president;* Dr. Adolph Eichhorn, of Pearl River, N. Y., *second vice-president;* Dr. C. J. Marshall, of Philadelphia, *third vice-president;* Dr. H. Preston Hoskins, of Chicago, *general secretary.*

THE American Veterinary Medical Association, which held its seventy-first annual convention in conjunction with the international gathering, elected Dr. Robert S. MacKellar, of New York City, president for the ensuing year to succeed Dr. C. P. Fitch, of St. Paul. Drs. G. A. Dick, of Pennsylvania; W. F. Guard, of Ohio; H. E. Curry, of Missouri; A. L. Mason, of the U. S. Army, and W. Wisnicky, of Wisconsin, were elected vice-presidents for one-year terms. Dr. M. Jacob, of Tennessee, was reelected treasurer.

DR. NORBERT KREBS, professor of geography at Berlin, has been elected a member of the Prussian Academy of Sciences.

PROFESSOR LUIGI DEVOTO, professor of industrial diseases at Milan, Professor Giuseppe Muscatello, professor of clinical surgery at Catania, and Professor Giunio Salvi, professor of human anatomy and rector of the University of Naples, have been elected members of the Italian Senate.

AT the ninetieth annual commencement the University of Michigan conferred the honorary degree of

doctor of engineering upon Lyman Foote Morehouse for his contributions to the art of communication.

PROFESSOR WILLIAM R. WESTHAFER, head of the department of physics and dean of the College of Wooster, has received the honorary degree of doctor of laws from the Ohio Wesleyan University.

DR. FRED H. ALBEE, professor of orthopedic surgery at the New York Post-Graduate Medical School, Columbia University, was presented with the New Jersey Distinguished Service Medal on August 16. Dr. Albee is chairman of the New Jersey Rehabilitation Commission, a post he has held since 1919. Because of his achievements in this capacity, the citation points out, "The state has excelled all others in its achievements for the amelioration of the unfortunate condition of the crippled."

PROFESSOR SAMUEL J. RECORD, of Yale University, has recently been honored through the naming of two genera of tropical trees: *Recordia boliviana* Moldenke and *Recordoxylon amazonicum* Ducke.

DR. VERN O. KNUDSEN, chairman of the department of physics at the University of California at Los Angeles, has been appointed dean of the Graduate School.

DR. LUDWIG EDELSTEIN, formerly of the University of Berlin, has been appointed associate in the history of medicine at the Johns Hopkins University School of Medicine.

R. E. PRIESTLEY, geologist and explorer, fellow of Clare College, University of Cambridge, and secretary-general of the faculties of the university, has been appointed vice-chancellor of the University of Melbourne.

DR. HARRY LEE PARKER has resigned his post as associate professor of neurology in The Mayo Foundation and as consulting physician in the section of neurology of The Mayo Clinic, to return to Ireland, where he has been appointed chief of the staff of the Neurologic Institute of Southern Ireland and professor of neurology, in Trinity College, University of Dublin. Dr. Parker is a graduate of the University of Dublin and went to the Mayo Foundation in 1919.

DR. JAMES STEVENS SIMMONS, major in the Medical Corps, U. S. Army, who has been director of the department of preventive medicine and director of laboratories at the Army Medical School in Washington, has been transferred to duty as president of the newly organized Army Medical Research Board at Ancon, Canal Zone.

THORNDIKE SAVILLE, professor of hydraulic and sanitary engineering at New York University, has been appointed executive engineer of the water resources investigation of the Federal Government. The investigations are being made by the National Resources Board to formulate a plan for the development of water resources over a period of years. Professor Saville is a member of the Federal Sanitary Commission at Washington.

J. S. LONG, since 1927 professor of chemistry at Lehigh University, has resigned to become the chemical director of Devoe and Raynolds Company, Inc., and its subsidiaries.

THE REV. FILIPPO SOCCORSI, S. J., has been appointed by Pope Pius XI director of the Radio Station at the Vatican, to succeed Father Gianfranceschi, who died on July 9.

DR. HERBERT S. JENNINGS, Henry Walters professor of zoology and director of the laboratory of zoology at the Johns Hopkins University, is spending the summer at the Hopkins Marine Biological Station, Pacific Grove, California.

DR. L. C. DUNN, professor of zoology at Columbia University, who has leave of absence for the coming year, sailed recently for Norway, where he will work at the University of Oslo.

DR. J. HORACE COULLIETTE, professor of physics, is returning to Birmingham-Southern College, after spending a year's leave of absence at Columbia University.

AT the University of California leave of absence has been granted to: Frank Adams, professor of irrigation investigations and practise, from August 1 to January 31, 1935, and to H. R. Tolley, a director, Giannini Foundation of Agricultural Economics, now serving as assistant administrator, Agricultural Adjustment Act, Washington, D. C., from July 1 to July 31, 1935.

DR. VICTOR E. LEVINE, professor of biological chemistry and nutrition at Creighton University School of Medicine, and Charles W. Bauer, professor of chemistry at the School of Pharmacy, are spending four months in the Arctic in research among the Eskimo children. They are making physical measurements and studies in nutrition. An investigation will be made of the susceptibility of the Eskimo child to tuberculosis, diphtheria and scarlet fever.

ACCORDING to *Nature* the Mendeléeff Centenary Lecture, which was delivered before the Chemical Society at the Royal Institution on April 19 by Lord Rutherford, has been printed in the *Journal* of the society.

ACCORDING to *Industrial and Engineering Chemistry* the annual meeting of the American Institute of Chemical Engineers will be held in Pittsburgh on November 15, 16 and 17. On November 14 there will

be a meeting of the council. The Hotel Schenley has been selected as the convention headquarters. Webster N. Jones, director of the College of Engineering, of the Carnegie Institute of Technology, is chairman of the committee on arrangements. He will be assisted by the following committee chairmen: Raymond L. Abel, Harrison C. Bashioum, J. H. James, Edward E. Marbaker, John T. Stearn, T. G. Timby, Mrs. Edward R. Weidlein and James H. Young.

THE fourteenth annual meeting of the Highway Research Board will be held in Washington, D. C., on December 6 and 7, in the building of the National Academy of Sciences and the National Research Council.

THE next general meeting of the International Astronomical Union, which is to be held in Paris in 1935, has been fixed for July 10 to July 17.

THE eleventh Prehistoric Congress of France will be held at Perigueux from September 16 to 22, under the presidency of Dr. Felix Regnault. The honorary general secretary and treasurer is M. Charles Schleicher. The principal sites of interest in the area will be visited and excavations demonstrated in the course of the meeting.

THE London *Times* reports that the members of the Ellesmere Land expedition arrived at Disko Bay, West Greenland, on August 5. They have been delayed by storms and head winds and the necessary precautions to avoid the loss of deck cargo. The expedition was organized by Dr. Edward Shackleton, and has the support of the University of Oxford, the Royal Geographical Society and the Canadian government. Dr. Noel Humphreys is the leader. Other members are Sergeant H. W. Stallworthy, Mr. A. W. Moore, Mr. Robert Bentham and Mr. D. Haig-Thomas. The chief objective is to make the first sledge journey across one of the glaciers of the United States Range into Grant Land, an unknown area to the north of Ellesmere Land, which is itself to the northwest of Greenland.

WORK is progressing rapidly on the library and the chemistry building at the University of Arkansas, Fayetteville, as well as on a building for the Medical School at Little Rock, the ground-breaking ceremonies being held on July 30. The cost of each of the three buildings approximates half a million dollars. Their erection at this time is made possible by a grant from the Federal Public Works Administration. It is expected that they will be completed in the late spring or early summer and ready for occupancy at the beginning of the school year in September, 1935.

THE department of geology and mineralogy of the School of Mines and Metallurgy of the University of Missouri has been the recipient of a collection of rocks and minerals, collected by Harry G. Davis, of Clayton, Missouri. This collection was obtained through the efforts of one of the recent alumni, Albert E. Pessin (1932) and Dr. O. R. Grawe. The collection is made up of nearly one thousand specimens of rocks, minerals and ores from many of the important mining localities of the world, and includes a number of rare minerals.

AN Associated Press dispatch reports that the Federal Surplus Relief Corporation will spend about $5,000,000 for recreational centers. Agents of the National Park Service are inspecting properties in many states and taking options where possible. The service is trying to obtain tracts in Georgia, Illinois, Indiana, Iowa, Kentucky, Maine, Massachusetts, Minnesota, Missouri, New Hampshire, North Dakota, Oklahoma, Pennsylvania, South Carolina and Virginia. When the land is bought members of the Civilian Conservation Corps and other relief workers will start building camps, trails and picnic grounds.

A NETHERLANDS institute for research on the characters of heredity in man and the biology of the races has been recently established. It is divided into three sections: (1) biogenealogy, (2) medical statistics on the examination of hereditary characters, and (3) anthropologic study on the biology of the races.

ACCORDING to the London *Times*, men distinguished in various branches of science have been nominated to act on the University of London Council for Psychical Investigation which has been formed to take over the work of the National Laboratory of Psychical Research. Although not officially connected with the university, the council has been chosen from professors and other members of the university who are interested in the scientific probing of alleged supernormal phenomena. The council members are: Dr. F. A. P. Aveling, assistant professor of psychology, University of London; Dr. Guy B. Brown; Dr. Cyril L. Burt, professor of psychology at University College; Professor J. C. Flugel; C. E. M. Joad, head of the department of philosophy and psychology at Birkbeck College; C. A. Mace; Professor J. MacMurray, Grote professor of the philosophy of the mind and logic since 1928; Dr. Eric D. Macnamara, physician to the West End Hospital for Nervous Diseases; S. G. Soal, the Rev. Professor E. S. Waterhouse, professor of the philosophy of religion, and Harry Price and Miss Ethel Beenham, secretary. Foreign correspondents representing seats of learning in most of the capitals of the world, including the British Dominions, have been nominated.

DISCUSSION

THE PHOTOMICROGRAPHIC REPRODUCTION OF DOCUMENTS

THE usual procedure followed by scientists in gathering information upon a given subject is to make notes or abstracts of original papers upon filing cards or miscellaneous sheets of paper. These are classified and filed in the most convenient manner for future reference. Naturally in this way it is rarely possible to record more than a very brief account of the work. It is therefore necessary, whenever details of the research are required, to refer to the original paper, either by borrowing the journal from the library or going there to consult it.

In some cases it is possible to obtain from the author separates of papers published in journals, and these may be kept for reference. This can be done, however, in only a relatively few cases. What is greatly needed is a procedure by which copies of any paper, no matter where or when published, may be obtained and filed by the individual worker for use whenever desired. Since filing cards are so convenient and in such general use the ideal system would be one in which the copy of the original paper could be attached to the same filing card upon which was written the title, reference, abstract, notes or other points in regard to the subject.

The method which seems best adapted to this purpose is that of photographing the original paper upon strips of film and pasting these in a window in the filing card. For reading, a miniature table projecting apparatus would be used. The individual worker would then be able to have on a filing card not only his abstract or notes but the original paper itself and could make a collection of all pertinent articles upon a given subject, file them in a very small space and refer to them at any time most convenient to him.

Attention was called in a recent article on "Reforms in Chemical Publication (Documentation)"[1] to the movements under way having for their object the amelioration of the publication and distribution of papers describing chemical research. It was suggested that a process involving the photographing of printed pages upon motion picture film and the mounting of such strips of film in filing cards might contribute towards the solution of this problem. Subsequent inquiries in regard to available apparatus which could be adapted to this purpose have permitted the conclusion that such a process is not only practical but can probably be operated at a very moderate cost. On the basis of this information it is now possible to offer more detailed suggestions in regard to the organization of a service of photomicrographic reproduction of documents.

For the production of photomicrographic copies of printed papers upon motion picture film, there have been developed various forms of apparatus which could be adapted to making the strips suitable for inserting in filing cards. It is suggested that the process should consist first in photographing the pages of the original paper upon 35 mm film and mounting the strips corresponding to the several pages of a given paper in a rather large filing card; second, using the negatives thus prepared and mounted for the preparation of positives of about one half the size, which would in turn be mounted in smaller filing cards and distributed in response to requests for copies of papers; finally furnishing to each one making use of such miniature copies of original papers contained in filing cards a compact table projecting outfit adapted to receive the cards and magnify the copy to the degree desired by the individual.

For the first stage of the process there have been developed many more or less automatic machines. They consist of a table upon which is mounted a frame in which the book or any page to be copied is held firmly, by springs or otherwise, against the under side of a horizontal glass plate. An upright supports a roll film camera attached to a movable arm. Graduations on the upright permit fixing the focal distance at the points required for pages of different size. Finally lamps on the two sides illuminate the page to be photographed. Such apparatus has been perfected to the degree that after placing the copy a single movement actuates the remaining operations.

Since a service furnishing photographic copies of printed articles would undoubtedly be called upon to supply a large demand its efficient organization would be necessary. In order to fill the many orders which would be received daily it would first be necessary to assemble the books or periodicals containing the articles to be copied. Proximity to a library would be indispensable. Upon the filing card in which the film would subsequently be mounted would first be copied, by means of a typewriter, the title, author, reference and such classification data as may be necessary. This card would then be put at the page of the book where the article begins. When a sufficient number of such cards in their respective books had been prepared, the operator of the copying machine would have only to place one book after the other in the frame, make the exposure and turn

[1] SCIENCE, 80: 2064, 70–72, July 20, 1934.

the pages until each article has been completely photographed. When the roll of film is exhausted it would be developed by the usual process and dried. It would then be cut and the sections corresponding to the various articles mounted in the filing cards previously prepared. These cards then become the master negatives for preparing as many copies of each paper as may be subsequently ordered. Such cards would also be made for exchanging with centers of documentation in other countries.

The second stage of the process would consist in making positives from the master negatives. A simple reducing camera would be employed, and the entire film strip mounted in one card would be reduced to one half size and photographed as a positive in one operation. Thus the entire series of pages of a given article would be reproduced simultaneously and as many copies made as desired. If the master negatives upon 35 mm film were mounted in two strips in a window opening 70 mm in width, the reduction to one half size would permit the use of 35 mm film for the positives. In this way only standard 35 mm film would be used in the process and a developing machine of only one size be necessary.

The positives made in this way would be mounted, as in the case of the master negatives, in windows in filing cards. These, of course, would have previously copied upon them in typewriting the title of the paper, author, reference, etc., in accordance with such information given upon the master negative card.

Since the cards could not be larger than would fit the carriage of an ordinary typewriter it is suggested that the master cards containing the negative should be about 21 cm wide by 14 cm high. This size would be sufficient to leave ample space around an opening of 70 × 161 mm in which two strips of 35 mm film, each containing 7 photographed pages, could be inserted. The cards for the positives, although requiring window openings only one half this size, should probably be nearly as large as the master cards, in order to leave ample space for the individual user to write such notes and observations as he might desire. Articles of more than 14 pages would require two or more cards.

There have been developed a great variety of projecting machines for both rolls of films and slides of various shapes and sizes. They consist simply of a source of light, the heat of which is not allowed to damage the slide, a film or slide holder and a lens. The screen to receive the image may be of any convenient form, attached to or separate from the remainder of the apparatus. In the case of a projecting apparatus for films mounted in filing cards, the source of light need not be intense, since only a relatively small magnification would be necessary. The screen could be improvised as desired and consequently the outfit reduced to its simplest form.

From the above discussion it is evident that the suggested process requires only such apparatus and materials as are already at hand. All that is necessary is to assemble the several elements and organize the work in a systematic manner.

In the entire process the most expensive machine is that, together with its camera of highly specialized character, used to photograph semi-automatically the printed pages. Preliminary quotations indicate that the complete photographing machine and camera will not cost more than one thousand dollars.

The reducing camera required for making positives from 35 mm negatives would probably have to be made to order but would certainly be of very simple construction and should not cost more than a few hundred dollars.

The developing machines for standard motion picture film are of course highly perfected and not of an expensive character.

Projecting apparatus suitable for reading the film can be obtained in a great variety of forms, the simplest of which could undoubtedly be produced in quantity for not exceeding ten dollars each.

The other materials required for the process are motion picture film, filing cards and the usual miscellaneous office furniture, such as desks, tables, filing cases, etc. It is probable that everything required could be assembled for about two to three thousand dollars.

The actual cost of the film, filing cards, developer and such material as will be consumed in the process is certainly very low. On the basis of reliable estimates it is probable that 5 cents will be a very liberal maximum cost of materials required in making a card containing the photographic reproduction of 14 printed pages.

The uncertain feature is naturally the cost of the labor involved. This it is impossible to estimate until the process has been put into active operation and the number of journal articles which can be copied per day by one operator has been determined. The success of this undertaking will of course depend upon the moderate price at which the cards can be sold. To those who have access to libraries the cost will be of greater concern than to those who do not. In both cases, however, it is the service rendered which is of first consideration. If this should be as great as it is reasonable to expect, the cost should certainly not be a serious obstacle to the operation of the process.

ATHERTON SEIDELL
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THE TACONIC AND APPALACHIAN OROGENIES IN THE HUDSON RIVER REGION

NORTHWARD from Kingston, New York, folding caused by the Appalachian orogeny trends about N–10–E, and unfortunately this direction is also parallel to the axis of Taconic (Ordovician) folding. Therefore, in this part of the Hudson River region, although the Ordovician formations were affected by at least two orogenies, geologists have heretofore been unable to find evidence, in trend lines or other structural features, that the Appalachian folding cuts across the earlier Taconic deformation.

Since cleavage gives an excellent clue to the type and direction of regional stresses, it was thought that a careful study and comparison of cleavage in the Ordovician with that in the Devonian formations might help to distinguish the Taconic and Appalachian orogenies.

Near the axis of Taconic folding, just west of Mount Washington, cleavage in the schists has a strike of N–10–E over a wide area. Along the Hudson River, wherever cleavage is well developed in the Normanskill (Ordovician) grits, it also has a strike of N–10–E.

The Esopus and Schoharie grits (Devonian) are usually within a mile of these Ordovician beds. Cleavage readings were taken at most of the good Esopus and Schoharie outcrops along the strike for some forty miles. It was found that, wherever well developed, the cleavage almost invariably had a trend of N 25–30 E. This cleavage must have been developed by stresses later than the Taconic; and it is noteworthy that the trend corresponds exactly to that of the Appalachian folding, farther south.

It, therefore, seems logical to assume that much of the deformation in the Ordovician beds along the Hudson River has been caused by the Appalachian rather than the Taconic orogeny. Moreover, a careful study of cleavage appears to offer the best means of unraveling the complicated structure of this region.

JAMES F. PEPPER

CORNELL UNIVERSITY

CULTIVATED APPLE CHROMOSOMES

IN a recent article on the chromosomes of cultivated apples[1] some eighteen varieties were classified as being either diploid or triploid, and a definite correlation between chromosomal number and meiotic behavior was pointed out.

There has been considerable interest in the problems presented by the larger groups of the Rosaceae, and discussions concerning the Pomoideae have centered about the relationship between "ploidy" and pollen sterility, chromosomal pairing and the origin of the tribe on the basis of chromosomal numbers and behavior.

Because of the interest in the cytology as well as because of certain practical values for the breeder and grower of apples, it has seemed feasible to extend the observations to include certain varieties which are listed herewith.

Baxter	n – 17, 2n – ca. 34
Kinkead	n – 17
Mann	n – 17
Mother	n – 17, 2n – ca. 34
Opalescent	n – 17
Rolfe	n – 17, 2n – ca. 34

It will be apparent that these varieties are all diploid. The correlation between diploidy and regularity of chromosomal behavior in meiosis, noted in diploids studied previously, has proved to be a characteristic of these diploids.

The technique employed was that of the previous investigation, namely, fixation with Carnoy's fluid and embedding in celloidin.

MURIEL V. ROSCOE

ACADIA UNIVERSITY

[1] Muriel V. Roscoe, "The Chromosomal Constitution of Certain Cultivated Apple Varieties," *Jour. Genetics*, 28: 157–167, 8 figs., 1933.

A HYPOTHETICAL "SANCTUARY" FOR OCEAN-DWELLING SEALS

A RECENT leaflet, signed by C. W. Hobley, secretary of the Society for the Preservation of the Fauna of the Empire, states that the Newfoundland sealing industry "is steadily declining" and that "this spring (1934) about eight ships went out and some 248,000 seals were killed."

He urges that an expedition "should be dispatched with qualified scientific observers, to study the bionomics of the two species involved (*viz.*, Hood and Harp seals) and further as an outcome of their observations to make recommendations regarding a sanctuary, and possibly some protection for immature animals."

The two kinds of seals mentioned—*Harps* and *Hoods*—are pelagic animals. They live in the open sea, and in early spring (usually March) resort to the Arctic ice floes—mainly those in the North Atlantic between Labrador and Greenland—to give birth to their young.

These great ice packs are steadily moving southward, steadily melting and soon disappear, and the seals, old and young, take to the open ocean—and as a rule are not again seen until the following year. They do not normally visit land but spend their entire lives in the sea, except for the brief period in early spring "when a still small voice within" invites them to visit the ice fields for purposes of procreation.

These being the facts, why should an expedition "be dispatched with qualified scientific observers to study the bionomics of the two species involved . . . and to make recommendations regarding a Sanctuary and possibly some protection for immature animals"?

Where, except on the Arctic ice fields where they whelp their young, could an expedition go to find either Harps or Hoods? And where could a sanctuary be established except on floating ice—ice that is melting and soon disappears in the wide ocean?

Had the author looked into the natural history of the American seals or the literature of the seal fishery, he would not have said: "It appears probable that the coast of Labrador is the breeding region and that the herds thence migrate south and southeast to the western and northern coasts of Newfoundland"—for he would have learned that these seals (Harps and Hoods) breed on the ice floes and—unless wounded by terrestrial or aquatic sharks—rarely visit the land at any time.

C. HART MERRIAM

LAGUNITAS, CALIF.

SPECIAL CORRESPONDENCE

EXPEDITIONS OF THE PHILADELPHIA ACADEMY OF NATURAL SCIENCES

WITH twelve expeditions in the field, ranging east and west from Tibet and Siam to Africa, and north and south from the Arctic to Bolivia, the Academy of Natural Sciences of Philadelphia is sponsoring one of the most extensive exploring and collecting programs undertaken since its establishment 122 years ago.

George Vanderbilt, of New York, is leading an expedition which has left Nairobi, British East Africa, for a five-month journey through central Africa to Timbuctoo, thence across the Sahara desert by tractor-truck to Algiers. With Mr. Vanderbilt are James A. G. Rehn, curator of the department of entomology, and Harold T. Green, curator of museum exhibits, and Baron von Blixen, the well-known African explorer. Among the animals sought are the bongo, a large antelope with most spectacular markings; the okapi, of which no museum has a mounted group; the giant eland, addax, scimitar-horned oryx and dwarf buffalo.

Brooke Dolan, II, of Philadelphia, will spend more than a year in the wilds of western China and the Tibetan borderland, collecting birds, mammals, fishes and plants. In 1931 Mr. Dolan made a similar expedition. He is now forming his caravan of yaks and coolies at Chungking, some 1,200 miles up the Yangste River from Shanghai, preparing for the 500-mile overland journey to Batang. The party includes Ernst Schaefer, zoologist, who accompanied Mr. Dolan on his first expedition and helped to secure the unique giant panda group now on display in the museum, and Marion H. Duncan, for many years a resident in Batang.

Through the courtesy of the Chinese government, this expedition will explore regions seldom, if ever before, visited by white men. Among the high peaks of the northeastern Himalayan range it will be necessary to reduce the packs to a minimum weight, hence the members of the party will depend for food largely on native game and yak's milk, with limited allowance of chocolate, coffee, sugar and cheese for variety. As gifts for a Chinese mandarin who aided his former expedition, Mr. Dolan is taking along two magnificent great danes from near Philadelphia, with the hope that they may be successfully crossed with the large and powerful Tibetan dogs which abound among the nomad tribes.

After four years of intensive work in Peru, making a study of the distribution, sources and relationships of the birds, M. A. Carriker, Jr., of the department of vertebrate zoology, now is extending his work into Bolivia, under a grant from the American Philosophical Society. His activities during the next six months will be confined to the northern part of Bolivia, covering a range from snow-line in the Andes to the level of the Rio Beni. Mr. Carriker is accompanied by his son, Melbourne R. Carriker.

To secure specimens of wapiti (American elk) and pronghorn antelope for habitat groups in the North American Hall, two trustees of the academy, Prentiss N. Gray, of New York, with his son, Sherman, and R. R. M. Carpenter, of Wilmington, Delaware, with his son, R. R. M. Carpenter, Jr., will spend six weeks in Wyoming, making their base at Mr. Gray's cattle ranch in the historic Jackson's Hole. They will be accompanied by C. Clarke Rosenkranz, artist of the staff, who will make color sketches of the group backgrounds, and collect plants, grasses and other natural accessories for the foregrounds.

These two animals, now reduced to mere remnants of the former vast herds, are among the most striking of North America's original game resources. The wapiti, which once ranged from Connecticut westward to California and northward from Tennessee and Texas to Ontario and British Columbia, is the largest member of the deer family, the bulls sometimes standing more than 5 feet at the shoulder, with magnificent antlers sometimes more than 5 feet long, with a spread up to 70 inches. As late as the early part of the last century there were large herds of elk in parts of Pennsylvania and New York, being so numerous in the Keystone state that Elk County was named for

them. The pronghorn antelope, first described in 1818 by George Ord, an early president of the academy, formerly ranged the entire country west of the Mississippi, their total number being placed at 40,000,000; now dwindled to perhaps 15,000.

In Siam, the permanent field staff, organized in 1928 by Rodolphe M. deSchauensee, a trustee of the academy and associate curator in the department of vertebrate zoology, is continuing the work of three earlier expeditions. With headquarters in Bangkok this collecting of birds, fishes, reptiles, insects and mammals extends into every part of Siam. To date the specimens received include some 4,500 birds, 6,000 fishes, 300 reptiles, 400 butterflies, 500 insects and 100 mammals. Among these are a number of new species.

Frank B. Foster, a trustee of the academy, planned to leave Philadelphia early in August for the Kenai Peninsula, Alaska, where he hopes to secure a bull moose of unusual size for a striking one-animal "group" in the North American Hall.

Dr. W. M. Benner, research associate in the department of botany, is collecting a general series of plants found in the more remote mountain regions of Texas, Arizona, New Mexico, California and Colorado. Among the objectives of his expedition will be the dwarf willow tree, only four to five inches high, which completes its seasonal activity in a few weeks; Alpine timothy a few inches high, which heads in an equally brief period and other plants that spring up as soon as the snow line recedes.

In the high plateau of central Mexico, Dr. Henry A. Pilsbry, curator of mollusks, and Dr. Francis W. Pennell, curator of botany, accompanied by Cyril H. Harvey, of Atlantic City, are collecting mollusks and plants, under a grant from the American Philosophical Society. The work of this expedition will aid in completing a chart of the route taken by mammals, mollusks, insects and plants which, over a period of some 3,000,000 years, moved northward from South America when the Isthmus of Panama was lifted above the waters 20,000,000 years ago.

For a three-months exploring and collecting trip along the west coast of Greenland, and as far north as Ellesmere Land, an expedition sponsored by R. R. M. Carpenter, of Wilmington, Delaware, a trustee, is now skirting the coast of Labrador in Captain Bob Bartlett's schooner *Morrissey*. The party is led by William K. duPont Carpenter, and includes Harry J. Lance, Jr., of the staff, Robert F. Dove and a representative of the Canadian government.

The object of this expedition is to secure specimens of birds and animals, and to collect fishes and other sea animals. It also is hoped that some definite information may be obtained as to the nesting and breeding habits of the greater snow goose and the common brant, two birds which summer in Arctic lands and in the autumn migrate southward to North Carolina, and even as far as Cuba. Thus far little is known about the summer life of these birds. The expedition will visit Cape York to inspect the Peary monument erected there last summer, then proceed to Ellesmere Land, where it is hoped specimens of Peary's caribou, a rare and striking white species, may be photographed or secured.

To continue the excavations near Clovis and Carlsbad, New Mexico, which last year revealed impressive indications that man lived in North America perhaps 15,000 years ago, the joint expedition for the academy and the University Museum of Philadelphia is working under the direction of Edgar B. Howard, research associate in the department of vertebrate zoology, who will be joined later by Ernst Antevs, geologist of the Carnegie Institution of Washington. Thus far the facts represent the association of the bones of extinct animals with human artifacts, and the search now is being intensified with the hope of finding human bones.

James Bond, research associate in the department of vertebrate zoology, on his eighth expedition to the West Indies, for a representative collection of birds, has added a number of species to the already extensive collection he has secured for the academy.

On a recent expedition to Louisiana, Edward Woolman, accompanied by Wharton Huber, associate curator of the department of vertebrate zoology, collected small mammals and birds, and secured moving pictures of the large numbers of blue geese that winter in that part of the United States.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

PHOTO-ELECTRIC TECHNIQUE FOR THE COUNTING OF MICROSCOPICAL CELLS

THE technique of progressive dilutions used by early bacteriologists to isolate species and to estimate the probable number of cells is still applied in the determination of quanta of viruses, bacteriophages and enzymes.

The isolation and counting of bacterial and fungic species have been so simplified by the introduction of solid culture media, differential stains and micromanipulation that the dilution technique, which in part is embodied in the standard plate count method, is no longer carried to its final point: *e.g.*, one organism per dilution bottle.

The following is a brief description of an attempt to

adapt photoelectric methods to the direct counting of microscopical cells in suspension in water.

A capillary glass tube, made from a small tube elongated over a gas flame, is placed under the high magnification field of a microscope. The microscopical cells in suspension in water (red blood cells or neutral-red stained yeast cells) are forced under pressure to circulate through the capillary tube. A photoelectric apparatus of the smaller type is adjusted to the microscope's ocular and connected with an appropriate meter. The purpose of the experiment is to have each microscopical cell passing through the capillary tube, register itself automatically on the photoelectric apparatus, thus creating a micro-current which can be amplified and recorded.

The technical difficulties to overcome in such an experiment can be listed as follows:

(1) Difficulty to standardize capillary tubes in such way as to fill exactly the highest magnification field.

(2) Difficulty to flatten capillary tubes (as suggested by Sturges in his studies on bacterial motility) to insure proper focus.

(3) Necessity to shake dilution samples thoroughly to prevent clumping of cells in capillary tubes.

(4) Desirability of a specific photoelectric apparatus highly sensitive to microscopical objects. The ordinary commercial photoelectric apparatus is not built or intended for such purpose and shows only a faint reaction to magnified erythrocytes, neutral-red stained yeast cells or microscopical solid particles.

ANDREW MOLDAVAN

MONTREAL, CANADA

A NEW SOURCE OF ILLUMINATION ADAPTED TO PHOTOGRAPHY AND LOW-POWER MICROSCOPY

AN adaptation of the so-called neon type of tubular light has given promise of furnishing satisfactory illumination both for the photography of small opaque objects and for the binocular microscope stage. The apparatus is made in the usual arrangement used for the neon type, namely, glass tubing filled with a combination of gases, which may be varied to control the spectrum range. A step-up transformer on the 110-volt lighting circuit supplies a potential of 2,000 or more volts across electrodes fused into each end of the tube. For the purposes mentioned the glass tube was shaped into a number of close, circular turns, forming either a single or double spiral. For use with the microscope a spiral of three turns has been found satisfactory, but for photography a larger number is more desirable to furnish as much intensity as possible. When in use the lighting unit is placed around the binocular microscope objective, about two inches from the object, or around the camera lens so that the photograph is made through the opening in the center of the unit. The inside diameter of the unit should be not less than two inches. A sleeve extending inside the light and fitted to a reflector back of the light shades the objective or camera lens, as well as increasing the efficiency of the apparatus. An arrangement to cover a variable sector of the unit allows control of the intensity and angle of the shadows so that perspective may not be lost.

This type of lighting is particularly advantageous because of the absence of intense heat, which would be detrimental to lens mountings or to the objects. The intensity of the light source is very even over all its area, so that even lighting of the object is obtained with no manipulation, and it is very easy to control the shadow intensity to suit the subject. Also there is no flare, such as is found in some forms of incandescent lighting. The cost of this type of unit is under ten dollars.

WILBUR D. COURTNEY
RALPH SCHOPP

U. S. DEPARTMENT OF AGRICULTURE,
SUMNER, WASH.

LANTERN SLIDES ON "FROSTED" GELATINE

SEVERAL communications relative to the use of Cellophane as a vehicle in the making of lantern slides have appeared recently in SCIENCE. With our aluminum-surfaced screens we find an undesirable glare develops even when yellow-tinted Cellophane is used. Furthermore, unless great care is taken, Cellophane does not take ink uniformly and exactness in delineation is sometimes sacrificed by this effect. Where compass work is required, however, Cellophane is far more convenient than commercial slides of clear or "etched" glass.

In searching for substitutes for Cellophane which will eliminate the difficulties mentioned we have found that *thin,* translucent, onion-skin paper is excellent. Colored inks provide for differentiation in diagrams when desired.

Better than the paper is a "frosted"—the trade term—gelatine sheet for flood lights by Klieg. When ink is applied to the matte surface of this sheet the roughening particles appear to dissolve, coalescing into a smooth, transparent surface when dry. Lines then appear in color on a gray background when projected. A startling fact is that perfectly white lines appear on the gray surface when drawn with plain water. With ink or water the change to transparency is immediate, drying almost as rapid, so that the slide works up very quickly. Details may be worked in with lead of pencils when required.

We have found that the gelatine sheets offer only one disadvantage—they are so sensitive to contact

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with water that impressions of the worker's fingers are recorded if the latter are damp. Wiping the fingers with alcohol, xylene or other "dryers" is helpful in avoiding this trouble.

By this method the cost of a slide is not more than one third that of an etched slide of similar appearance prepared with transparent "inks."

C. E. POWER

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SPECIAL ARTICLES

AUTOCATALYTIC ACTIVATION OF TRYPSINOGEN IN THE PRESENCE OF CONCENTRATED AMMONIUM OR MAGNESIUM SULFATE

THE writers have described[1] the isolation from fresh cattle pancreas of a crystalline protein ("chymo-trypsinogen") which is transformed by a minute amount of active trypsin into an active proteolytic enzyme "chymo-trypsin." The course of the activation reaction is monomolecular and its rate is proportional to the trypsin concentration. Chymo-trypsinogen can not be activated by entero-kinase while the mother liquor from the chymo-trypsinogen crystallization is activated by entero-kinase but not by trypsin under ordinary conditions.

Subsequent experiments have shown that a protein fraction which has a very slight activity can be obtained from this inactive mother liquor. This fraction becomes highly active, as measured by the digestion of hemoglobin or casein, if allowed to stand for several hours in the form of a suspension in 0.5 saturated ammonium or magnesium sulfate at about pH 7.0 and 30° C. The activation follows the course of an autocatalytic reaction except for a prolonged lag period. The final specific activity is about 80 per cent. of that of crystalline trypsin. If a fresh suspension is inoculated with some of a perviously activated suspension activation occurs very rapidly. Active trypsin may thus be "propagated" by inoculating a suspension of the inactive protein with active material.

The suspension is prepared for activation as follows. The mother-liquor from the chymo-trypsinogen crystallization previously described is precipitated by bringing to 0.7 saturated ammonium sulfate and filtered. One gram of this filter cake is dissolved in 7.5 ml M/5 phosphate or borate buffer pH 8.0 and then 7.5 ml saturated ammonium sulfate is added. The suspension contains about 1.5 mg of protein nitrogen per ml.

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[1] M. Kunitz and J. H. Northrop, SCIENCE, 78: 558, 1933; *Jour. Gen. Physiol.* (in press).

CRYSTALLINE PROGESTIN

THE preparation from corpus luteum extract of crystalline material possessing progestin activity has been reported by Fels and Slotta,[1] Fevold and Hisaw,[2] and Allen.[3] None of these workers gives details as to the physical and chemical properties of their preparations. In a joint investigation carried on in the Rochester and Columbia laboratories we have succeeded in isolating several crystalline compounds from the product obtained by Allen's procedure. The main constituent of the mixture is a physiologically inactive compound, A, melting at 190° and possessing the composition $C_{21}H_{34}O_2$. This compound is a hydroxy ketone; its phenylurethane, p-nitrobenzoate and semicarbazone have been prepared.

A compound, B, with the formula $C_{21}H_{30}O_2$ crystallizing from ether-petroleum ether in blunt prisms with a melting point of 128° proved to possess the characteristic physiological properties of the hormone. It causes progestational proliferation in the uterus of the castrated rabbit in doses from 0.5 to 1.0 mg. A potency of 1 rabbit unit per mg has been tentatively assigned to this compound. Since the compound yields a crystalline dioxime, both oxygen atoms must be present in the form of carbonyl groups. The ultra-violet absorption spectrum of this compound shows a single band with a maximum at 240 mμ, which according to Menschick, Page and Bossert[4] is characteristic for α,β-unsaturated ketones. Compound A in the same concentration does not absorb light in the photographic region.

Furthermore, a compound, C, melting at 120–121° and crystallizing from ether-petroleum ether or dilute methyl alcohol in needles, has been isolated. This substance is also physiologically active; its potency is the same as that of Compound B within the limits of accuracy of the assay. Its ultra-violet spectrum is identical with that of Compound B. On combustion it gives the same figures for hydrogen as B, but somewhat lower carbon figures. On treatment with semicarbazide both compounds C and B yield apparently the same amorphous semicarbazone, which is

[1] E. Fels and K. H. Slotta, *Klin. Woch.*, 10: 1639, 1931.

[2] H. L. Fevold and F. L. Hisaw, *Proc. Soc. Exp. Biol. Med.*, 29: 620, 1932.

[3] W. M. Allen, *Jour. Biol. Chem.*, 98: 591, 1932.

[4] W. Menschick, J. H. Page and K. Bossert, *Ann. Chem.*, 295: 225, 1932.

aracterized by its low solubility in most organic lvents. The melting point behavior of both subances on repeated melting leads to the supposition at Compound C is an isomorphous modification of ompound B.

Finally, another physiologically inert compound, D, ystallizing from petroleum ether in rhomboidal latelets with a melting point of from 70 to 74°, has en isolated from the crude crystalline material. he amount so far obtained is too small for chemical aracterization.

From the above findings we are inclined to consider ompound B, M.P. 128°, as identical with the horone causing progestational proliferation and tentively propose to retain the name Progestin for is compound.

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LIFE SPAN OF PLATYPOECILUS, XIPHOPHORUS AND THEIR HYBRIDS IN THE LABORATORY

SEVERAL inquiries have appeared in print relative the length of life of these fishes under laboratory nditions. Perhaps the data here presented will rnish a partial answer.

Unfortunately, complete or quantitative data are t available for the reason that laboratory procedure such that exact records of the life span are not tainable, except in relatively few instances. From ch mating as many as ten progenies may be proced. Each is placed in a separate tank soon after irth. Males isolated from all the progenies of one ating are thrown together in one tank. As the maining females approach maturity, conservation space and tanks often makes it expedient to conntrate several of the progenies from the same matg, thus placing together fish of several different ges. Hence, in most cases, the age of any individual sh is known only between certain limits. In addion, very few fish are permitted to live out a "norhal" life span. Ordinarily they are killed as soon as eir function in a particular mating has been performed.

In a few instances, however, where only one progeny is obtained or a fish is singled out for one eason or another, exact ages are determinable. The ecords have been examined for such cases and the ata tabulated in Table 1. Preliminary tabulations howing no appreciable differences in the males and emales for each species and their hybrids, all males nd females whose ages at death are known are listed n the two first columns. The same data are re-

TABLE 1

Age in months	Male	Female	P	X	H
10	5	11	9	2	5
13	3	6	7	0	2
16	2	2	3	0	1
19	3	7	5	0	5
22	3	5	3	1	4
25	2	5	4	2	1
28	3	2	1	2	2
31	1	5	3	1	2
34	0	2	0	1	1
37	0	2	0	1	1
40	1	2	2	0	1
	23	49	37	10	25
Av.	19.5	20.8	18.7	25	21.2

entered in the three last columns without regard to sex. P, X, H stand for Platypoecilus, Xiphophorus and hybrid, respectively. The hybrids may be F_1, F_2 or any of several types of back crosses.

I have no way of knowing the cause of death, although it seems probable that in most cases it is not old age. Where it is obvious that something is the matter with a fish just before death, a note is made in the records, such as, "oedema," "melanoma," "very feeble," etc. Such cases are not included in the tabulation.

Among the older specimens are several not included in the table because the exact age is not determinable; they were killed and preserved or were still alive when the last record was made and with no later entry to indicate their fate. Such specimens are listed below:

1 male	P	57–61	months.	Died.
2 female	X	37	"	Killed.
3 male	X	36	"	"
7 female	X	36	"	"
1 female	X	32	"	Alive when last recorded.
1 female	P	32	"	Killed.
6 female	P	28	"	Alive when last recorded.
1 female	X	48–52	"	Still living (4–3–34).

It is obvious that the averages given in Table 1 are too low; a matter of no great significance, however, since there can not very well be a "normal" life span in the laboratory unless very special conditions as regards food, crowding, plant growth, cleaning, parasitic infection, etc., are rigorously maintained. The figures may, however, give some indication of the life expectancy of these fishes under ordinary laboratory conditions.

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SEXUAL RHYTHM IN THE PELECYPOD MOLLUSK TEREDO

IN a recent paper,[1] it was shown that in the varieties of *Teredo navalis* found at Woods Hole, Massachusetts, and in Long Island Sound, the great disparity in sex ratios observed at different seasons of the year was dependent upon the protandric nature of the species. Nearly all young animals pass through an initial functional male phase and most of these later become females. Selection of the largest members of a heterogeneous population in the breeding season will, as a rule, yield fully 90 per cent. females, since they will include the older individuals which have already completed the earlier and briefer male phase of sexual activity. The smaller animals will correspondingly consist mainly of young individuals, those that are sexually mature being in the functional male phase.

It was found that the young animals reach the functional male phase in three to six weeks after completing the free-swimming stage. The body is then only 15 to 30 mm in length as compared with 150 to 200 mm or more when the animal is fully grown. The female phase is usually assumed immediately after the discharge of the spermatozoa. This phase normally extends through the rest of the breeding season and this is not infrequently coextensive with the life of the individual.

No proof was then available that a second change of sex might occur, but it has now been found that in some individuals the two sexual phases may be repeated during the animal's second breeding season.

Such a condition results when the individual survives the winter after having completed spawning as a female in the autumn of its first breeding season. Following the last ovulation of the season the gonad retains only small ovocytes and such primary gonia as had remained inactive on the walls of the ovarian follicles during the reproductive period. Residual large ova, which are sometimes numerous when the lowered temperature and other environmental changes bring an end to ovogenesis, undergo cytolysis and eventual phagocytosis. The conditions which check ovogenesis evidently stimulate the proliferation of the spermatogonia.

During the winter the gonad thus resembles the primary bisexual gland of the sexually immature young animal, except for its much greater size and vastly more numerous constituent cells. As is the case in the young individual, the spermatogenic cells proliferate rapidly, in preparation for the functional male phase, which will be reached in early spring. By the middle of April ripe spermatozoa may be abundant.

All the medullary cells participate in spermatogenesis, but before the spermatozoa have been discharged the cortical layers of ovocytes have begun the formation of yolk. The lumens of the alveoli may still retain a few spermatozoa in the early part of the functional female phase, which follows as soon as the ova have completed their growth.

A second functional male phase, followed by a second female phase with several periods of ovulation may thus take place during the individual's second breeding season. The life of the teredo is usually short as compared with that of many mollusks, but if any individuals survive a second winter it seems not improbable that additional phases of a similar nature in this sexual rhythm may sometimes occur.

Because of the length of the breeding season, which extends from May to October, and the consequent overlapping of broods, the population will at all times during this period contain some individuals in each of the functional sexual phases. The requisites for cross fertilization are thereby assured whenever the temperature and other environmental conditions bring about the spawning reactions.

In addition to those animals which complete their first female phase there are in the autumn others representing all stages of the life cycle—(*a*) young sexually immature individuals, (*b*) young in the first male phase, (*c*) young which are just entering the female phase, and (*d*) older, partially spawned females, as well as (*e*) some so-called true males which are thought to retain the male phase indefinitely.

There will always be a great excess of animals in the male phase in early spring, not only because of those which have previously spawned as females but more particularly because of the more numerous young individuals in the initial male phase. These survive the winter in much greater numbers than do the older age groups.

The sexual rhythms in *Teredo* are therefore very similar to those described for various species of oysters,[2,3] although the usually shorter life of the former limits the number of the alternating sexual phases.

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[1] W. R. Coe, "Sexual Phases in Teredo," *Biol. Bull.*, 65: 283–303, 1933.

[2] J. H. Orton, "Observations and Experiments on Sex change in the European Oyster," *Jour. Mar. Biol. Assoc.* 15: 967–1045, 1926–7.

[3] W. R. Coe, "Alternation of Sexuality in Oysters," *Amer. Nat.*, 68: 236–251, 1934.

BOOKS RECEIVED

CHARLES, ENID. *The Twilight of Parenthood.* Pp. vi + 226. Norton. $2.50.

WILLCOX, O. W. *Reshaping Agriculture.* Pp. 157. Norton. $2.00.